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The Black Grain Stem Sawfly and the European Wheat Stem Sawfly in the United States

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INTRODUCTION

During the period 1934–37 the black grain stem sawfly (*Cephus* (*Trachelus*) *tabidus* (F.))[2] (fig. 1) became a serious wheat pest in western Pennsylvania and eastern Ohio. The insect is rapidly spreading farther westward each year and threatens to invade the entire wheat-growing region of the North Central States. It has already traversed Virginia as far as the south-central tier of counties, and, although not yet abundant in that State, it is becoming more important in the northeastern portion each year. These recent outbreaks give this insect greater economic significance than has heretofore been attributed to the European wheat stem sawfly (*Cephus pygmaeus* (L.)). Damage to wheat by the latter has been largely confined to New York and eastern Pennsylvania.

NATURE OF DAMAGE TO WHEAT

Serious losses are caused by the black grain stem sawfly during years of heavy infestation owing to the habit of the sawfly larvae of so cutting the wheat stems that they usually fall over shortly before harvesttime and cannot be picked up by the binder. In heavily infested fields, such as the one shown in figure 2, the necessity of raking up the fallen wheat seriously increases the difficulty of

[1] This work was conducted under the supervision of C. C. Hill and J. S. Houser furnished distribution records of *Cephus tabidus* for Ohio and helpful suggestions.

[2] RIES, DONALD T. SUPERFAMILY CEPHOIDEA, FAMILY CEPHIDAE. *In* Ross, Herbert H. A Generic Classification of the Nearctic Sawflies (Hymenoptera, Symphyta). Ill. Biol. Monog. 15 (2) : 114–116. 1937.

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harvesting. When raking is necessary there is danger of shattering, especially if the wheat is of a variety that shatters readily, is overripe, or has been allowed to lie in the field and dry out too long.

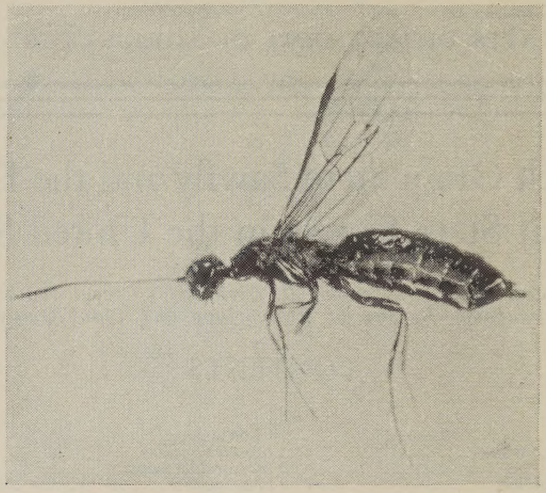

FIGURE 1.—Adult female of the black grain stem sawfly, × 5.

FIGURE 2.—Wheat 50-percent infested by the black grain stem sawfly. Cut stubble showing fallen stems, North Lima, Ohio. Photograph by J. S. Houser.

Raked wheat is also likely to contain sticks, stones, and other foreign material that may damage the thresher.

Past experiments in which the grain from infested stems was compared with that from noninfested stems, regardless of stem size,

indicated that the weight and quality of the grain is unaffected by the larvae. Recent experiments, however, have indicated that the adult sawfly selects the larger stems in which to oviposit, and a comparison with regard to average culm diameter showed that there was a definite loss of grain from infested stems.

It has been observed that wheat is more susceptible to injury during dry years. The early drying of the wheat hastens the development of the sawfly larvae and their descent to the base of the plants, and also causes the wheat stems that have been cut by the larvae to break off more quickly than is the case in years when there is more moisture in the plants. Breaking over was particularly in evidence during the dry season of 1934, when heavy loss was experienced from this source. In the summer of 1937 infestations were also heavy, but there was much moisture and the larvae were unusually slow in reaching the bases of the plants and cutting the stems, with the result that there was comparatively little breaking over before harvest.

Under moderate infestations the thin stands of wheat show more fallen straws than do heavy stands, even though the infestations are the same. In a strong, heavy stand the wheat stems tend to support one another.

The losses resulting from the European wheat stem sawfly are usually less than those from the black grain stem sawfly, and in normal years little wheat falls at harvesttime. Undue delay in harvesting, however, as well as the effects of storms, wind, or dry seasons, will cause serious falling. Wheat fields with an infestation by this species as high as 65 percent have been recorded.

HOST PLANTS

In the United States the black grain stem sawfly attacks wheat and, to a lesser extent, rye, and in Russia it has been reported as attacking barley.

The European wheat stem sawfly has been reported from wheat, rye, and barley, and has been recorded by Ries[3] as taken from *Bromus secalinus* in New York.

HISTORY AND DISTRIBUTION

The black grain stem sawfly was first collected sometime prior to 1899 at Riverton, N. J., and until 1919[4] had been reared or collected only from scattered localities in Pennsylvania, Maryland, Delaware, and Virginia. A survey in 1919 showed the insect to be established in southeastern Pennsylvania, New Jersey, nearly all of Maryland and Delaware, northern Virginia, and the panhandle of West Virginia. Its spread westward and southward since that time is illustrated in figure 3. By 1925 the insect had reached western Pennsylvania, and by 1927 it had gone considerably farther southward into Virginia. In 1929 it was found in Hanover County, Va., and in 1931 the boundary

[3] RIES, DONALD T. A BIOLOGICAL STUDY OF CEPHUS PYGMAEUS (LINNAEUS), THE WHEAT-STEM SAWFLY. Jour. Agr. Res. 32 : 277–295, illus. 1926.

[4] GAHAN, A. B. BLACK GRAIN-STEM SAWFLY OF EUROPE IN THE UNITED STATES. U. S. Dept. Agr. Bul. 834, 18 pp., illus. 1920.

of its distribution was extended to Mercer County in western Pennsylvania.

In 1934 this sawfly appeared in abundance in western Pennsylvania and adjacent counties of eastern Ohio and was found to have entered Campbell County in southern Virginia. Since that year heavy annual infestations have occurred in Ohio, and the limits of infestation have been extended both westward and southward in that State, whereas in Virginia it has been found both in Pittsylvania and Halifax Counties on the southern border. In 1937 this pest maintained heavy abundance in eastern Ohio, but its infestations were comparatively light in other sections of its range. Damage,

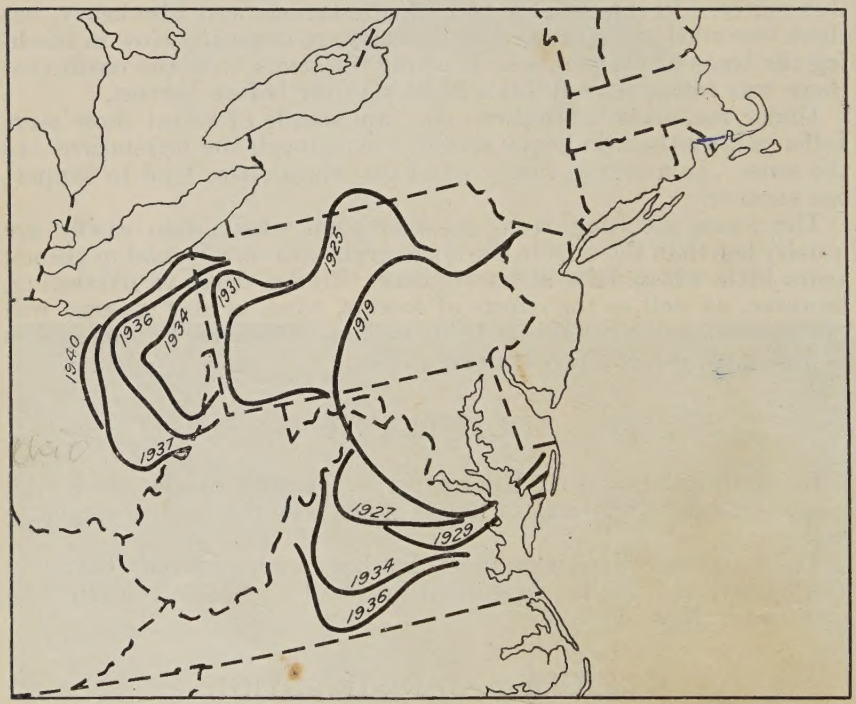

FIGURE 3.—Known spread of the black grain stem sawfly from 1919 to 1937.

however, was less that year than usual, owing to the presence of much moisture and sufficient delay in the development of the sawfly larvae for harvesting to be accomplished before the infested stems broke.

The period from 1938 to 1940 is characterized by a general reduction in sawfly activity. Infestations were low and except for a small westward extension of the infested area into Huron and Morrow Counties, Ohio,[5] no further change has been noted.

In eastern Pennsylvania the black grain stem sawfly is gradually being replaced by the European wheat stem sawfly, an Old World

[5] HOUSER, J. S. THE BLACK WHEAT-STEM SAWFLY. Ohio Agr. Expt. Sta. Bimonthly Bul. 25 : 151, illus. 1940.

insect that was first recorded in America in 1887 at Ithaca, N. Y.,[6] and found only in that State until 1919, when it was discovered invading Pennsylvania. At that time the European wheat stem sawfly was found in some of the wheat-growing areas along the Susquehanna Valley, although a preponderance of the black grain stem sawfly was in evidence. By 1927 certain parts of the east-central section of the Valley showed the two species in equal abundance, and by 1936 most of eastern Pennsylvania and parts of the Susquehanna Valley were infested chiefly by *Cephus pygmaeus*, *C. tabidus* having become rare. The approximate distribution of the two species in the United States in 1937 is shown in figure 4.

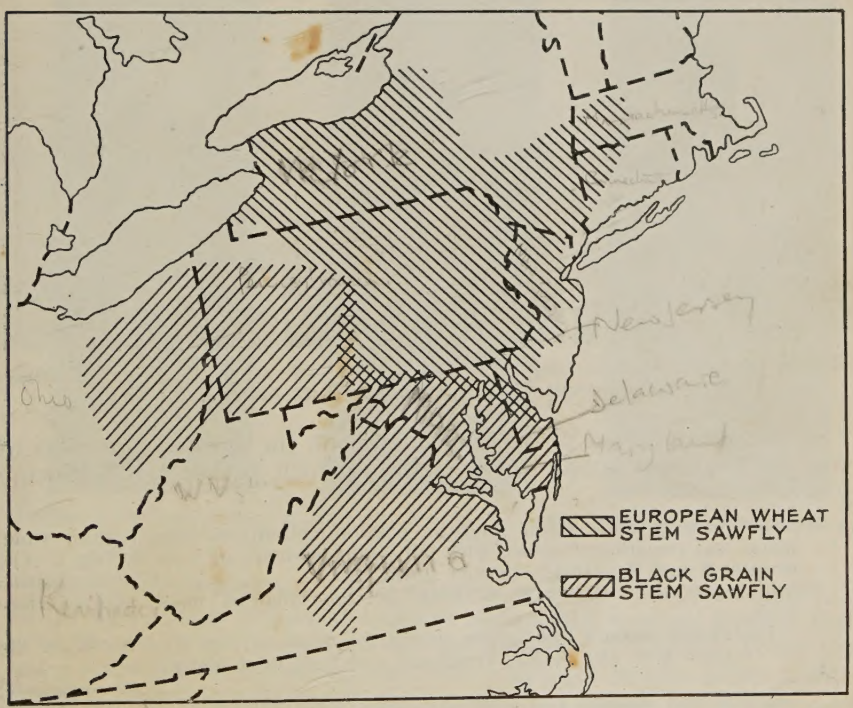

FIGURE 4.—Known distribution of the black grain stem sawfly and the European wheat stem sawfly in 1937.

Recent observations indicate that in areas where both species are present *Cephus pygmaeus* adults emerge about a week earlier than those of *C. tabidus*. In view of these observations, and since more than one sawfly egg is often found in a wheat stem, although only one larva reaches maturity, it may be assumed that the larvae of *C. pygmaeus* destroy eggs and ensuing larvae regardless of species. This relationship may account for the reduction of *C. tabidus* in the areas where *C. pygmaeus* is present.

[6] NEW YORK (CORNELL) AGRICULTURAL EXPERIMENT STATION, ENTOMOLOGICAL DEPARTMENT. A SAW-FLY BORER IN WHEAT. CEPHUS PYGMAEUS. ORDER HYMENOPTERA; FAMILY TENTHREDINIDAE. N. Y. (Cornell) Agr. Expt. Sta. Bull. 11: [127]–142, illus. 1889.

IDENTIFICATION OF WHEAT-INFESTING SAWFLIES BY LARVAL CHARACTERISTICS

In view of the increased interest in the wheat-infesting sawflies, due mainly to the westward spread of the black grain stem sawfly and the increased distribution of the European wheat stem sawfly, the following keys and illustrations have been devised to aid in rapid and accurate identification of the mature larvae. The wheat stem sawfly (*Cephus cinctus* Nort.) is included because of its occurrence in this country, although it is not yet known to inhabit the area where the other species are found.[7]

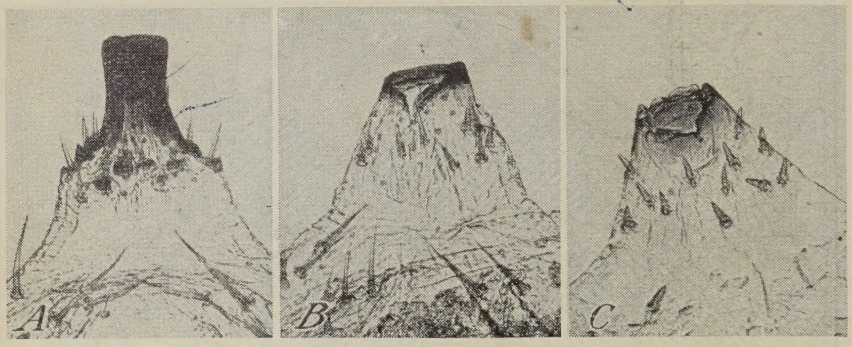

FIGURE 5.—Suranal processes of the larvae of wheat-infesting sawflies: *A. Cephus cinctus; B. C. pygmaeus; C, C. tabidus.* × 160.

Upon examination under the microscope the suranal processes of the larvae show certain characteristics which permit the following classification:

Suranal process with distal sclerotic portion cylindrical, longer than wide, distal end smooth and entire with but slight evidence of a notch (fig. 5, *A*); tergites 8 and 9 without distinct hairs ..... *Cephus cinctus.*

Suranal process with distal sclerotic portion ringlike, much shorter than wide.

Distal end smooth and entire except for more or less of a notch on the ventral side (fig. 5, *B*); tergites 8 and 9 without distinct hairs ..... *C. pygmaeus.*

Distal end serrate and irregular, with more or less of a notch on the ventral side (fig. 5, *C*); tergites 8 and 9 with distinct hairs ..... *C. tabidus.*

Cephus pygmaeus and *C. tabidus* can also be differentiated by an examination of the severed grain stub with the help of a pocket lens or with the unaided eye. The larva of *C. pygmaeus* does not completely sever the wheat stem but leaves some of the epidermis uncut, and as a result there is an irregular, ragged edge at the point where the stem is broken (fig. 6, *A*). The larva of *C. tabidus*, on the other hand, cuts more completely, and the stem when finally separated presents a finely serrated edge (fig. 6, *B*). The cut made by the larva of *C. cinctus* (fig. 6, *C*) is similar to that of *C. tabidus*. This similarity, however, will not at present cause the two species to be confused, because the areas of distribution do not overlap.

[7] AINSLIE, C. N. THE WESTERN GRASS-STEM SAWFLY A PEST OF SMALL GRAINS. U. S. Dept. Agr. Tech. Bul. 157, 24 pp., illus. 1929.

LIFE HISTORY

Cephus tabidus lays its egg in the upper internodes of the wheat stem about the time the wheat begins to head. The egg hatches in 4 to 7 days. The larva feeds on the inner lining of the stem and gradually works its way downward, eating through the septa of the nodes, until it has become full grown and has reached the base of

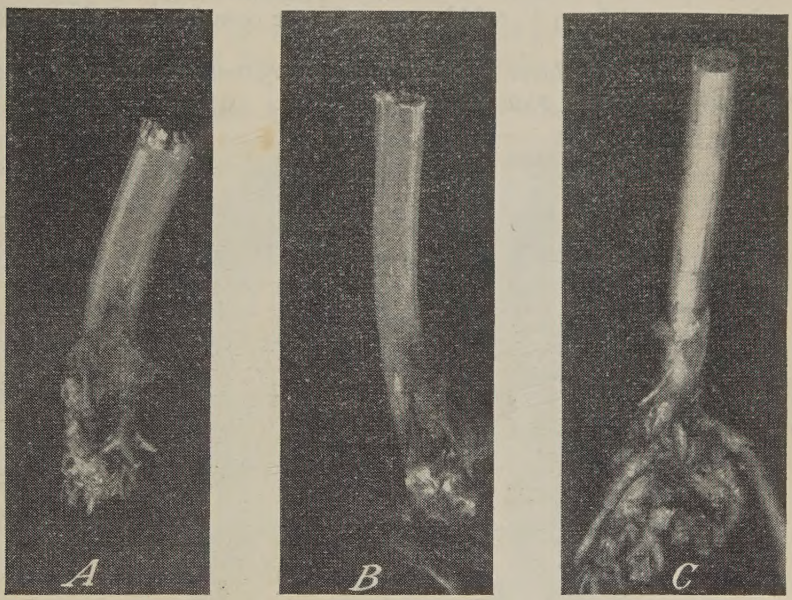

FIGURE 6.—Wheat stubs cut by sawfly larvae: *A*, *Cephus pygmaeus*; *B*, *C. tabidus*; *C*, *C. cinctus*.

the plant at harvesttime. It then forms a plug in the stem and just below this cuts a V-shaped incision completely around, leaving just enough outside fiber intact to hold the stem erect. Directly below the cut a second plug is formed, and under this the sawfly forms a silk-lined, cylindrical cell (fig. 7, *A*), in which it spends the winter. As the stem dries and becomes more brittle, the weight of the head, together with the action of wind or rain, breaks it off. The remaining stub is left in the ground with the inactive larva (fig. 7, *B*) inside until the following spring, when pupation and emergence take place. There is only one generation a year.

The life history of *Cephus pygmaeus* is similar to that of *C. tabidus* except that the adults of *C. pygmaeus* appear about a week earlier than those of *C. tabidus*.

INSECT PARASITES

In this country the major parasite of *Cephus tabidus* is a small chalcid, *Pleurotropis benefica* Gahan. It oviposits in the egg, and the resulting solitary larva completely destroys the host by the end of summer. *P. benefica* also attacks *C. pygmaeus*. Two ichneumonids, *Hoplocryptus* sp. and *Epiurus* sp., are occasionally reared

from both species of sawfly larvae, but these have never been found in sufficient numbers to be of any economic importance. In 1936 and again in 1937 a braconid, *Microbracon terebella* (Wesmael), heretofore recorded only from Europe, was reared from *C. tabidus* material collected in Crawford County, Pa. *Eupelmus allynii* French has been recorded twice as reared from *C. tabidus* and has also been recorded from *C. pygmaeus*.

Heterospilus cephi Rohwer the major parasite of *Cephus pygmaeus*, has been reared from *C. tabidus* on only one occasion and then under artificial conditions.

Eupelmella vesicularis (Retzius) and *Eurytoma* sp. have also been reared from *Cephus pygmaeus*.

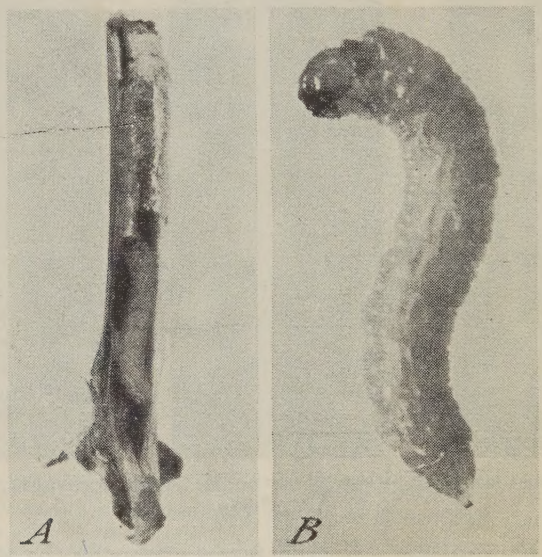

FIGURE 7.—*A*, Wheat stub with side removed showing silken cell containing black grain stem sawfly larva, × 2; *B*, sawfly larva, × 8.

In England the ichneumonid *Collyria calcitrator* (Gravenhorst) is an effective parasite of *Cephus pygmaeus*. This parasite is now being introduced into this country by the United States Department of Agriculture through the courtesy of the Canadian Department of Agriculture, as a means of biological control of both *C. pygmaeus* and *C. tabidus*.

CONTROL MEASURES

Plowing stubble under at least 6 inches with a clean turn-over of the slice reduces the numbers of larvae surviving in it, but unless this practice is carried out as a community endeavor sawflies may invade the new crop the following year from unplowed stubble located in neighboring fields. Moreover, in present infested areas this method of control cannot very well be adopted because of the well-established and desirable custom of sowing clover or timothy in the standing wheat early in the spring.

To avoid much loss from falling straw in heavily infested areas, the wheat should be cut just previous to maturity. In this way the crop can be harvested before much lodging due to sawfly injury occurs. Obviously the combine harvester, which operates successfully only in mature, dry grain, is not suitable for use in heavily infested fields. However, the fallen straw can be harvested after the regular harvest with a pick-up attachment supplied for most combines by the manufacturers. This procedure considerably increases the cost of operation.

When raking has to be resorted to, it is good practice to rake early in the morning while the wheat is still damp, in order to reduce shattering.

Cultural practices and fertilizers which encourage a strong, heavy stand help materially to reduce losses due to sawflies and are recommended throughout the infested areas.

SUMMARY

The black grain stem sawfly (*Cephus* (*Trachelus*) *tabidus* (F.)), first collected in this country prior to 1899, has spread from its original location in New Jersey until at present it is found as far west as central Ohio and as far south as the Virginia-North Carolina line. Injury to wheat has become more intensive in the newly inhabited areas of western Pennsylvania and eastern Ohio than in other sections of the distribution area. The infested wheat stems, especially in dry years, break off where they have been cut by the sawfly larvae, causing loss from shattering and inconvenience and loss in harvesting.

The European wheat stem sawfly (*Cephus pygmaeus* (L.)), first recorded in New York in 1887, has spread southward through the eastern half of Pennsylvania to Maryland and Delaware, replacing the black grain stem sawfly.

The life histories of the two species are similar except that the adults of *Cephus pygmaeus* appear about a week earlier. There is but one generation a year.

Both sawflies attack wheat and to a lesser extent rye.

Identification of the sawflies infesting wheat in the United States can be accomplished by an examination of the suranal processes of the mature larvae. *Cephus tabidus* and *C. pygmaeus* can also be differentiated by the characteristic type of cut made by the larva on the wheat stub.

The major parasite of *Cephus tabidus* is *Pleurotropis benefica* Gahan., and the major parasite of *C. pygmaeus* is *Heterospilus cephi* Rohwer. Attempts are now being made to establish the ichneumonid parasite *Collyria calcitrator* (Gravenhorst).

Deep plowing of the stubble, with a clean turn-over of the slice, to reduce the sawfly population, is recommended where such procedure is feasible. Encouraging a strong stand of wheat by applications of fertilizers and suitable cultural practices also aids in reducing loss. Where infestation is heavy much loss may be avoided by harvesting the wheat just before maturity.

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